

SOUTH FORK SALMON RIVER- SUMMER CHINOOK SALMON HATCHERY PROGRAM REVIEW

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Introduction and background

The South Fork Salmon River (SFSR) summer Chinook Salmon mitigation program was established to provide in-place and in-kind mitigation for summer run Chinook Salmon losses associated with construction and operation of the four lower Snake River hydroelectric dams (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor). McCall Fish Hatchery is located on banks of the Payette River approximately one-half mile downstream of the outlet of Payette Lake in McCall, Idaho. Construction of this hatchery and the associated satellite facility was completed in 1980. The satellite facility is located on the mainstem SFSR approximately 113km upstream from the confluence with the Salmon River. All adult trapping and spawning for this program occur at this satellite facility. In 2007, a permanent concrete sill and catwalk were constructed at this site that allows for trapping the entire adult return. Prior to 2007, a removable picket weir was used to divert fish into the trap but lacked the structural integrity to efficiently trap throughout the adult migration. Locations of both the hatchery and satellite facility are shown in Figure 1.

The LSRCP adult mitigation goal for the McCall Fish Hatchery is 8,000 adult Chinook Salmon above the Project Area (Lower Granite Dam) and 32,000 adults available for downriver (Columbia and lower Snake rivers) harvest. The original smolt release target of 1 million yearling smolts was based on an assumed smolt-to-adult survival rate (SAR) of 0.80% back to the project area and a smolt to adult survival rate (SAS) of 4.0% back to the Columbia River mouth (Table 1). All smolts are transported from the McCall Fish Hatchery and released directly into the upper SFSR at Knox Bridge (RKM 115) approximately one mile upstream of the adult trap.

Table 1. Adult return goals for LSRCP funded Chinook Salmon reared at McCall Fish Hatchery.

Run	Project Area Goal	Downstream of Project Area Goal	Total Adult Goal
Summer	8,000	32,000	40,000

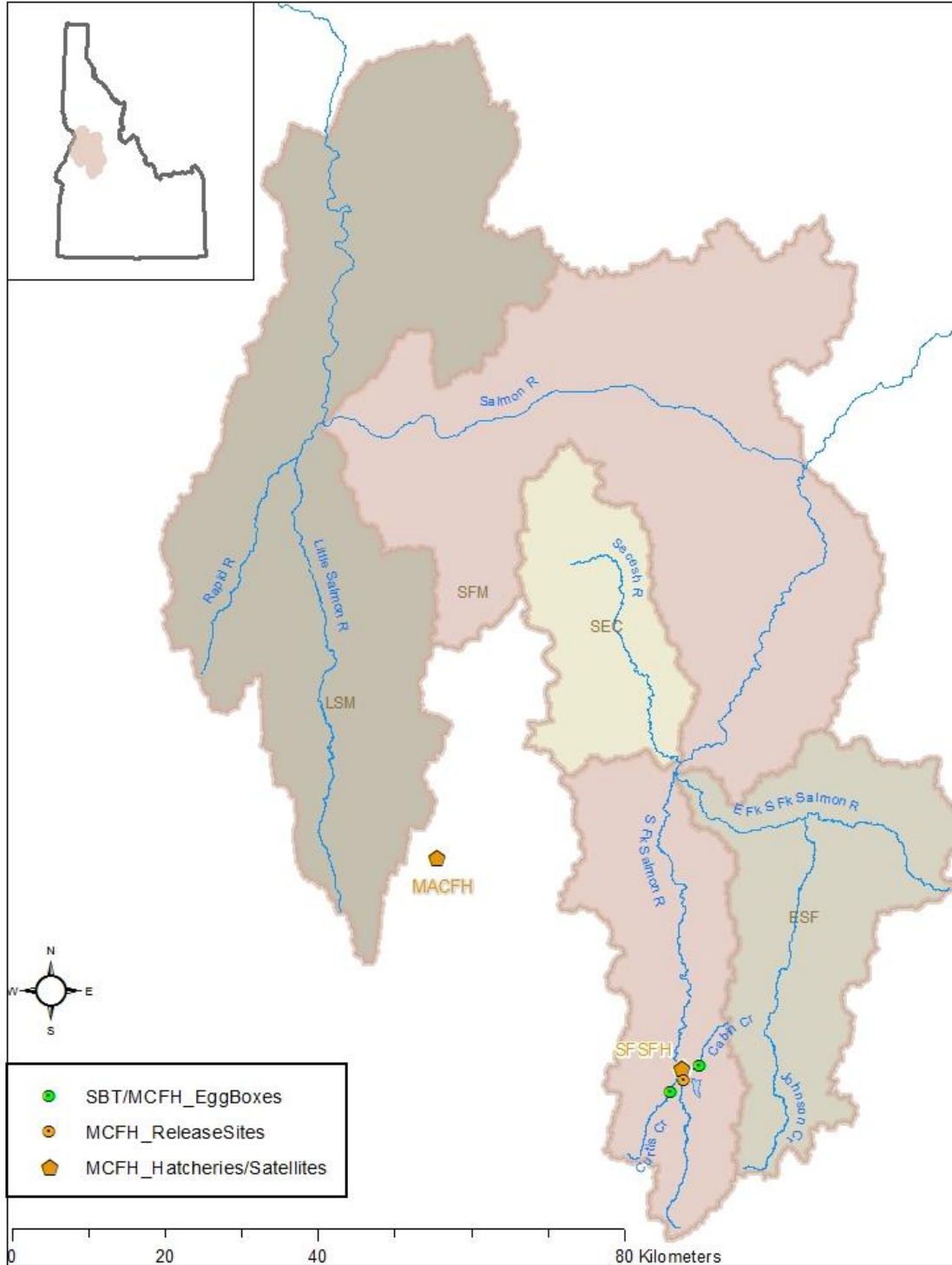


Figure 1. Map of the South Fork Salmon River Major Population Group (MPG) and locations of hatchery facilities and juvenile release location associated with the LSRCP funded production at McCall Fish Hatchery.

Production and management changes since last ISRP review

The smolt production target of 1.0M yearling smolts has been consistent throughout the duration of the program.

Historically, the SFSR program has been managed as a segregated broodstock. Beginning in 2010, managers changed it to a stepping-stone integrated broodstock consistent with programmatic recommendations from the Hatchery Scientific Review Group (HSRG) in 2009.

The change to managing with an integrated broodstock was chosen for two primary reasons. 1) An integrated broodstock maintains genetic continuity with the natural population and guards against risk associated with the unintentional spawning of hatchery fish with the natural population downstream of the weir. 2) Managers have chosen to supplement the natural population upstream of the hatchery weir with integrated hatchery adults to increase the abundance of natural fish in the population. The integrated broodstock minimizes domestication selection and results in hatchery fish that are more similar to the natural population as compared to a segregated broodstock. The stepping-stone approach was chosen because the number of natural-origin adults returning to SFSR trap has been insufficient to fully integrate a hatchery program with at 1.0M smolt production target. As such, when natural-origin adult returns are less than 700 adults, the integrated component of the broodstock is comprised of 150,000 smolts. Adult returns from these smolts are used to supplement the natural spawning population upstream of the weir. Additionally, a portion of these adults are incorporated into the broodstock that is used to produce the remaining 850,000 smolts thereby maintaining a genetic linkage between the natural and hatchery fish. As the abundance of natural origin adults increases through time, the proportion of the program that is integrated with natural adults will also increase with the goal to fully integrate the entire program.

Due to uncertainties associated with the effectiveness of supplementation, a project (BPA project 2010-031-00) was initiated in 2010 to assess the effectiveness of supplementation associated with the programs at Sawtooth, Pahsimeroi, and McCall fish hatcheries (Venditti et al, 2022).

Objectives for the integrated program include targeting a Proportionate Nature Influence (PNI) of 0.5-0.67. To achieve this high PNI, we target using 90% natural origin fish in the broodstock. The first Integrated adults returned in 2014 and since then returns of both integrated and natural adults have been very low which is consistent with other populations in the Snake River. As a result, the PNI target has only been met in two of eight years during the period 2014-2021.

ESA status and consultation history

The SFSR hatchery program is contained with the South Fork Salmon River Mainstem population that is part of the South Fork Salmon River MPG and Snake River ESU (Figure 1). The South Fork Salmon River MPG contains four populations (East Fork South Fork Salmon River, Secesh River, SFSR Mainstem, and Little Salmon River). All natural populations of spring/summer Chinook Salmon in the SFSR MPG are part of the ESU. The hatchery-origin Chinook Salmon from McCall Fish hatchery are also part of the ESU and are included in the listing.

The Snake River spring/summer Chinook Salmon ESU was listed as threatened in 1992. In the recent 5-year status review by the National Marine Fisheries Service, it was determined that there was no new information that would warrant a change in the listing status (NMFS 2022). None of the populations in the South Fork Salmon MPG meet viability criteria, and the South Fork Salmon River Mainstem population is currently rated at high risk for abundance and productivity and moderate risk for spatial

structure and diversity.

Through consultation with NMFS and the USFWS, two Biological Opinions (WCR-2017-7319 and 01-EIFW00-2017-1079) were completed in 2017 that established take limitations for ESA listed species including spring/summer Chinook Salmon, Fall Chinook Salmon, steelhead, and Bull Trout that are impacted by operation of the spring/summer Chinook Salmon hatcheries in the South Fork Salmon River MPG. The non-tribal fishery associated with this hatchery program is operated in accordance with IDFG's Fishery Management and Evaluation Plan (IDFG 2011).

Broodstock history

Initial broodstock for the SFSR program was collected at Little Goose and Lower Granite dams from 1974 to 1979. In 1980, broodstock was collected at both Lower Granite Dam and the upper SFSR. Since 1981, broodstock collection has been exclusively from adults collected at the SFSR satellite facility.

Broodstock goals

Broodstock collection targets are established annually through the AOP process for all facilities. A "Broodstock Calculator" is used to calculate the number of adults to be trapped and spawned based on a five-year running average of survival metrics (i.e., adult pre-spawn mortality, fecundity, disease culling rate, eye-up rate, and eye-release survival). Current broodstock targets for the McCall Fish Hatchery include trapping 1,028 adults for the smolt production and an additional 203 adults to produce 300,000 eyed-eggs for the Shoshone-Bannock Tribe's egg-box program in the SFSR. The number of natural adults collected and incorporated into the brood varies annually and is based on a sliding-scale of abundance for the number of natural fish that arrive at the trap.

Management and monitoring and evaluation objectives

Management Objectives for the SFSR hatchery program are to meet the LSRCP adult mitigation objectives, restore and maintain tribal and non-tribal fisheries in the Salmon River basin and minimize the impact of the hatchery program on the natural Chinook Salmon populations in the upper Salmon River consistent with objectives outlined in IDFG's Fisheries Management Plan (IDFG, 2009). Additionally, managers are investigating the utility of supplementation as a tool to provide a conservation benefit of increasing the number of natural-origin spawners. Monitoring and evaluation (M&E) objectives for the Upper Salmon River program include monitoring production, productivity, and life history characteristics of hatchery and natural populations and to evaluate broodstock and rearing strategies to increase and maximize adult returns. Monitoring and evaluation of the natural population consists of a comprehensive fish-in, fish-out monitoring program that follows fish from the cradle to the grave via sampling at screw traps, snorkel surveys, and spawning ground surveys in addition to juvenile and adult sampling at Lower Granite Dam. For IDFG, monitoring of natural populations in the Salmon R basin is funded through the BPA Fish and Wildlife program under project 1990-055-00. Monitoring and evaluation efforts in the SFSR are a cooperative effort between IDFG and the NPT.

In-Hatchery and Post-Release Performance

Adult pre-spawning mortality

Average pre-spawn mortality rates for male and female summer Chinook Salmon at McCall Hatchery have varied widely between years (Figure 2). The most recent 10-year mean is 16%. The mean rate over the entire time series is relatively low at 13%, although there are several years with values greater than 25%. The highest value recorded was 71% in 2014, when a severe weather event caused flooding and excessive sediment loading in the South Fork Salmon River and the adult holding facilities. Rates in excess of 25% were also recorded during the 2002, 2003, 2008, 2009, and 2013 brood years. These higher rates were observed during periods of elevated water temperatures and increased turbidity. With an increasing occurrence of excessive water temperature in more recent years at the SFSR trap site, managers are moving forward with construction of adult holding facilities at McCall Fish Hatchery where there is access to cooler water. After construction is complete, the broodstock will be transferred from the SFSR trap to the McCall facility annually as part of a new operating procedure.

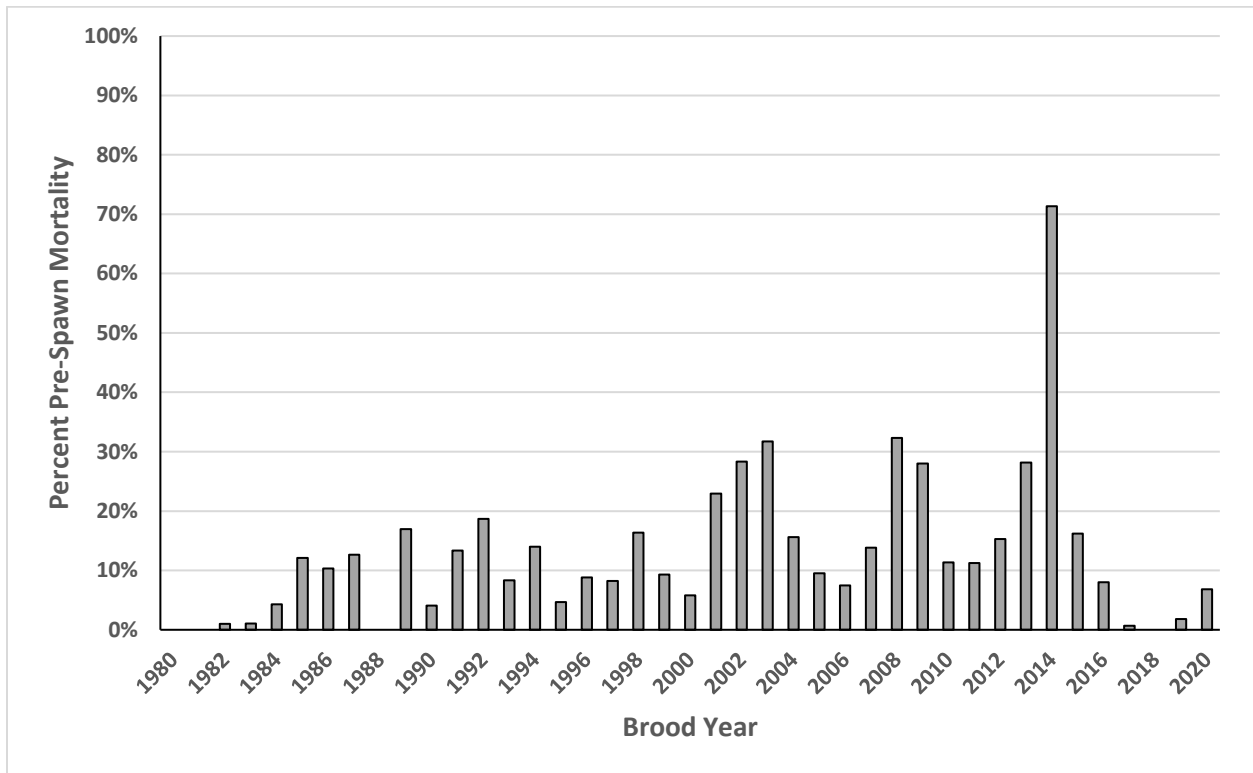


Figure 2. Pre-spawn mortality rate of summer Chinook Salmon at McCall Fish Hatchery, 1980-2020.

Egg to smolt survival

Average survival from eyed-egg to release at McCall Fish Hatchery for summer Chinook Salmon is 84% over the entire time series and 83% for the most recent 10 years (Figure 3).

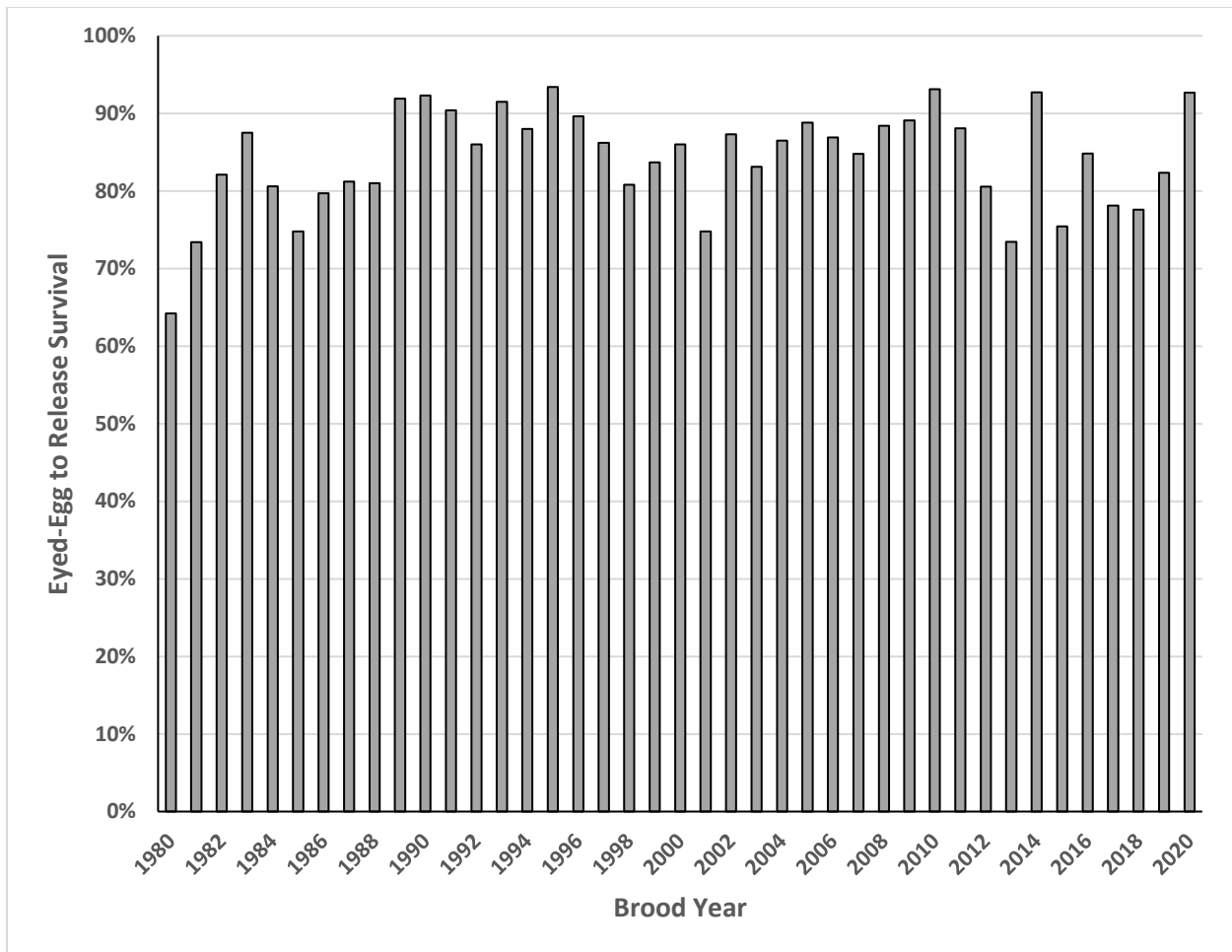


Figure 3. Eyed-egg to release survival of McCall Fish Hatchery summer Chinook Salmon smolts, 1980 – 2020.

Juvenile releases

Production targets for juvenile releases of summer Chinook Salmon from McCall Fish Hatchery have remained consistent since the program’s inception (Figure 4). A sub-yearling release strategy was utilized in the 1900s and early 2000s but due to the poor performance relative to yearling smolts, were discontinued. Since brood year 2009, all fish have been released as yearling smolts. With few exceptions, notably during the program building years from 1977 into the early 1980’s and during region-wide population declines of the mid-1990’s, annual production goals have been consistently met.

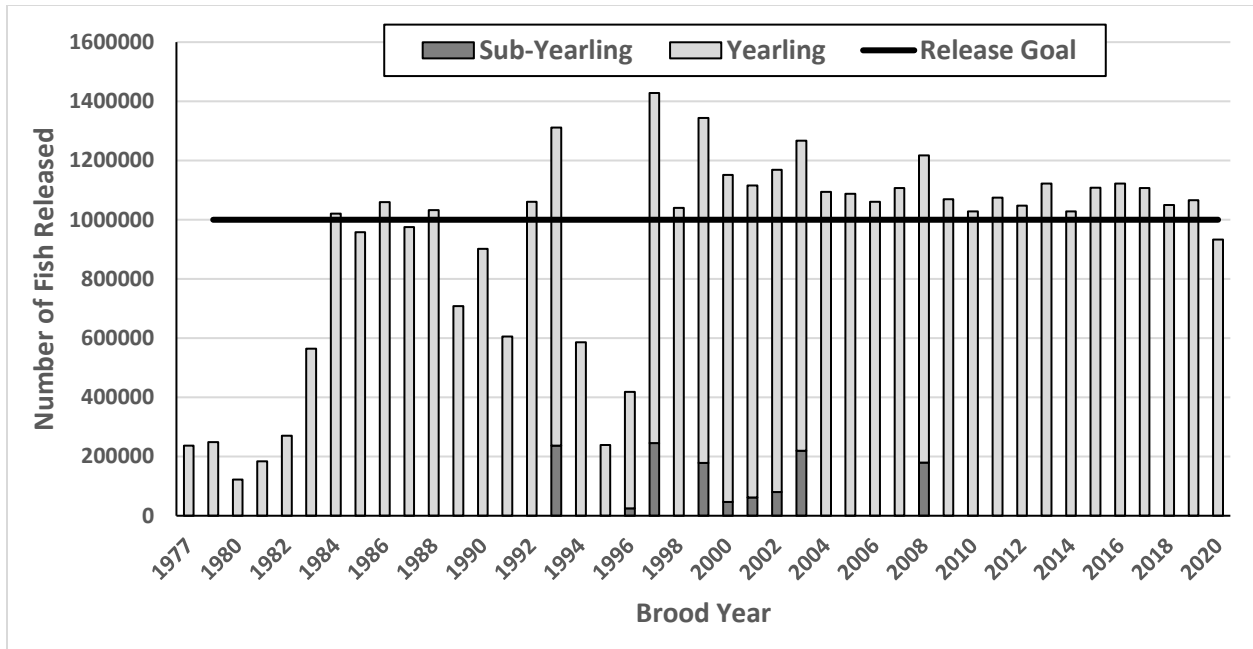


Figure 4. Release target and actual number of juvenile summer Chinook Salmon released from McCall Fish Hatchery, 1977-2020.

Juvenile survival from release to Lower Granite Dam

Juvenile release groups for summer Chinook Salmon have been representatively tagged with Passive Integrated Transponders (PIT) tags since brood year 1991 and are used to estimate juvenile survival from release to Lower Granite Dam. Since 1997, PIT tagging efforts increased (number tagged per release group) as part of a cooperative effort with the Comparative Survival Study (McCann et al., 2021) and to provide estimates of adult returns for survival analysis and for in-season fisheries management.

Estimated survival of juvenile summer Chinook Salmon from release to Lower Granite Dam has varied by year, averaging 61% since 1991 (Figure 5). Survival estimates have trended upwards across the time series, and the most recent 10-year average is 69%.

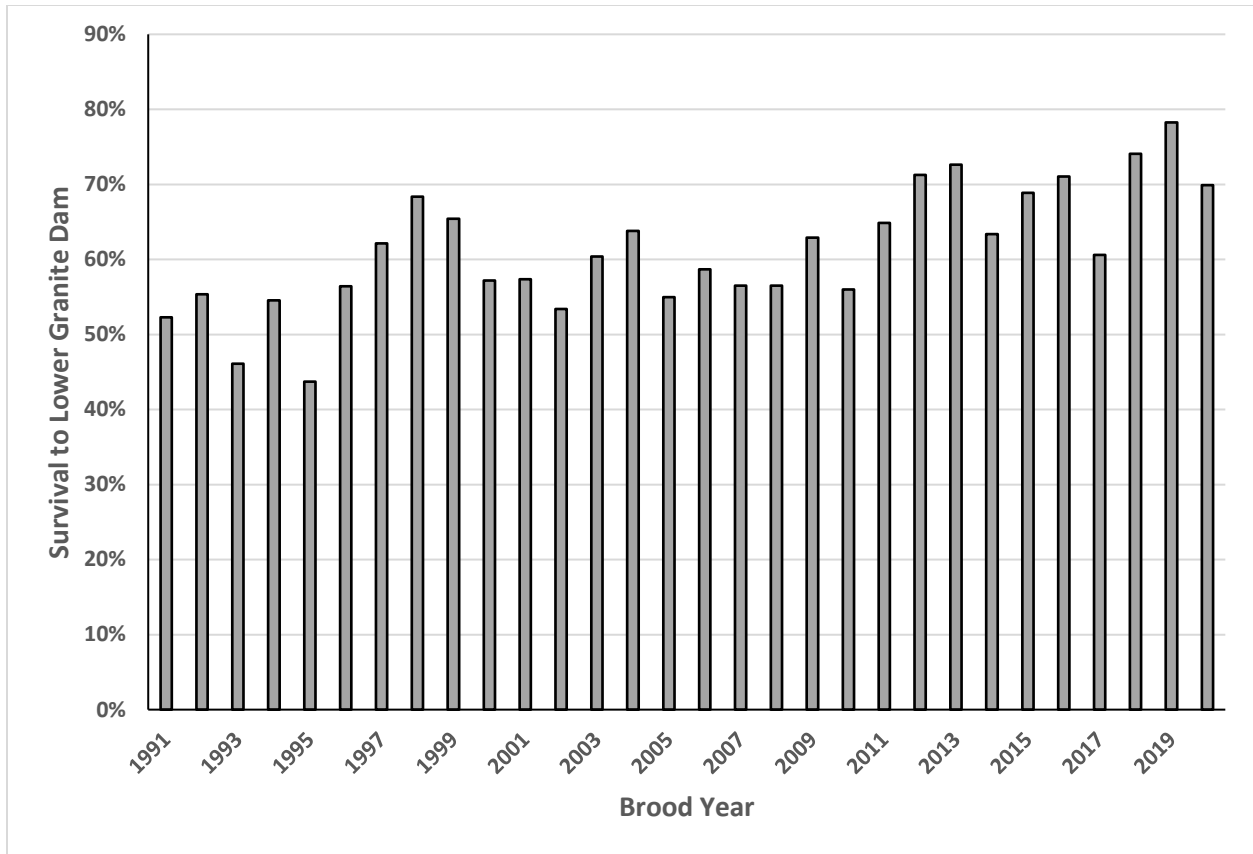


Figure 5. Estimated survival, from release to Lower Granite Dam, of yearling summer Chinook Salmon smolts released from McCall Fish Hatchery for brood years 1991-2020.

Adult returns to the Project Area (mitigation goal)

The LSRCP adult mitigation goals for programs in Idaho are measured as adult returns above the Project Area and are defined as returns to Lower Granite Dam. For McCall Fish Hatchery, the goal is to return 8,000 adults annually to Lower Granite Dam.

Prior to return year 2012, adult returns to Lower Granite were estimated indirectly from a traditional run reconstruction. Adults were accounted for on the spawning grounds, returns to the trapping facilities, and estimates of harvest in the tribal and non-tribal fisheries upstream of Lower Granite Dam. All of these components were summed to estimate the return to Lower Granite Dam. Beginning in 2012, adult returns to Lower Granite Dam have been estimated directly from a systematic sampling program and use of Parental Based Tagging (PBT) to assign sampled fish to their hatchery, stock, and cohort of origin (Belnap et al., 2021).

While the first two decades of McCall Fish Hatchery history was marked by poor adult returns, the program met the Project Area adult return goal eleven times between 2000 and 2015 (Figure 6). Similar to other wild and hatchery populations, adult returns from McCall Fish Hatchery at Lower Granite Dam have decreased significantly since 2015 (Figure 7).

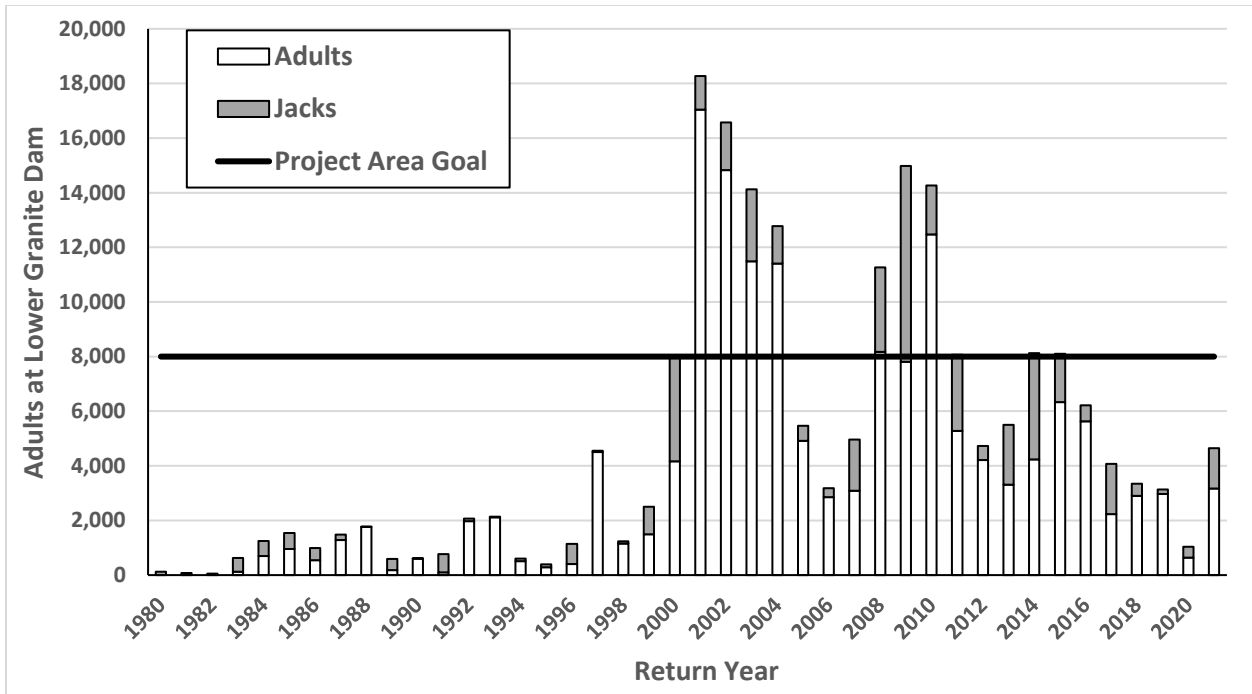


Figure 6. Estimated number of McCall Fish Hatchery adult Chinook Salmon at Lower Granite Dam 1980-2021. The black horizontal line represents the Project Area return goal for McCall Fish Hatchery.

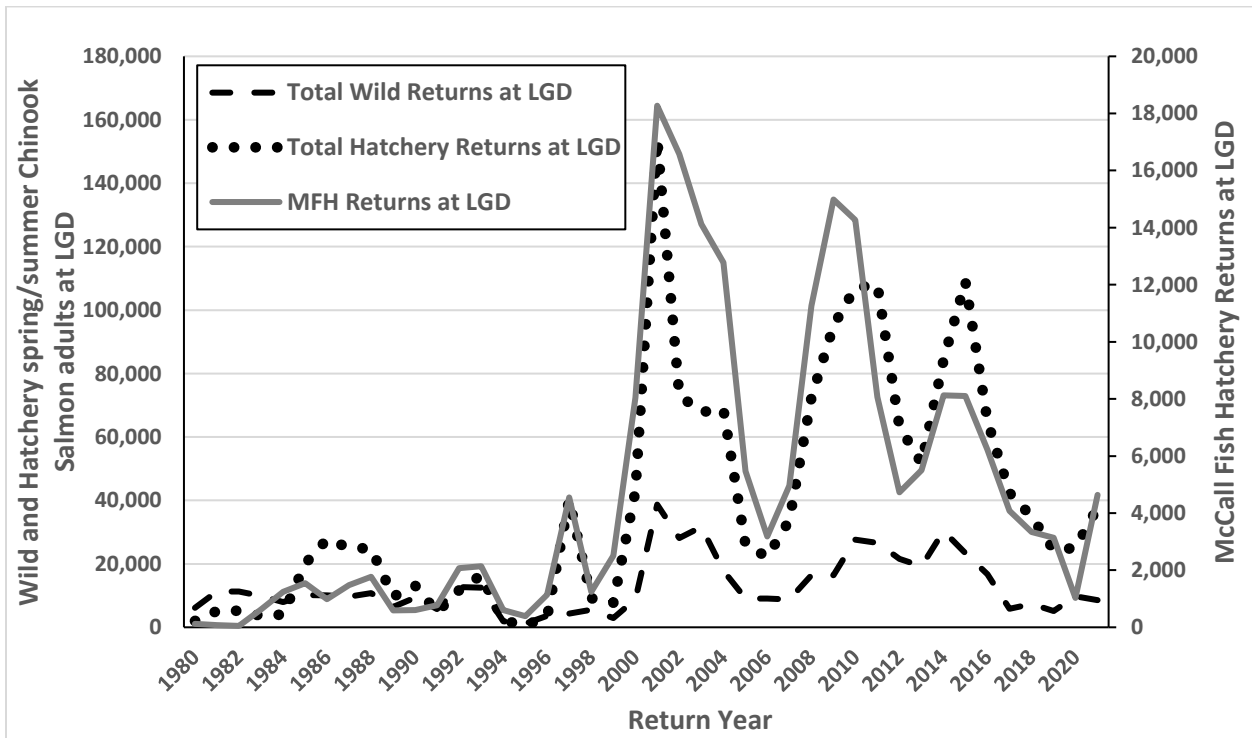


Figure 7. Estimated number of hatchery-origin adults from McCall Fish Hatchery (MFH) and the total hatchery and wild return of spring/summer Chinook Salmon at Lower Granite Dam, 1980-2021.

Smolt-to-adult return (SAR)

Smolt-to-adult return rate (SAR) in this report is defined as the fraction of juveniles released that return to Lower Granite Dam as adults. Adults from a single cohort return over three years as one-, two-, and three-ocean adults. Stock and cohort specific estimates at Lower Granite Dam are determined based on PBT analysis described in the “Adult Returns to Project Area” section above. Based on the current smolt production target of 1.0M yearling summer smolts at McCall Fish Hatchery, an SAR of 0.80% is necessary to achieve the adult mitigation goal to the Project Area (8,000 adults).

Smolt-to-adult return rates for McCall Fish Hatchery summer Chinook Salmon have varied substantially since the implementation of the program (Figure 8). The SAR goal has been met or exceeded in nine years throughout the history of the program, with a mean of 0.56% (range: 0.05% - 1.9%) over the entire time series. SAR values have declined for the most recent five years for which estimates are available, with brood year 2016 being the lowest on record since 1992.

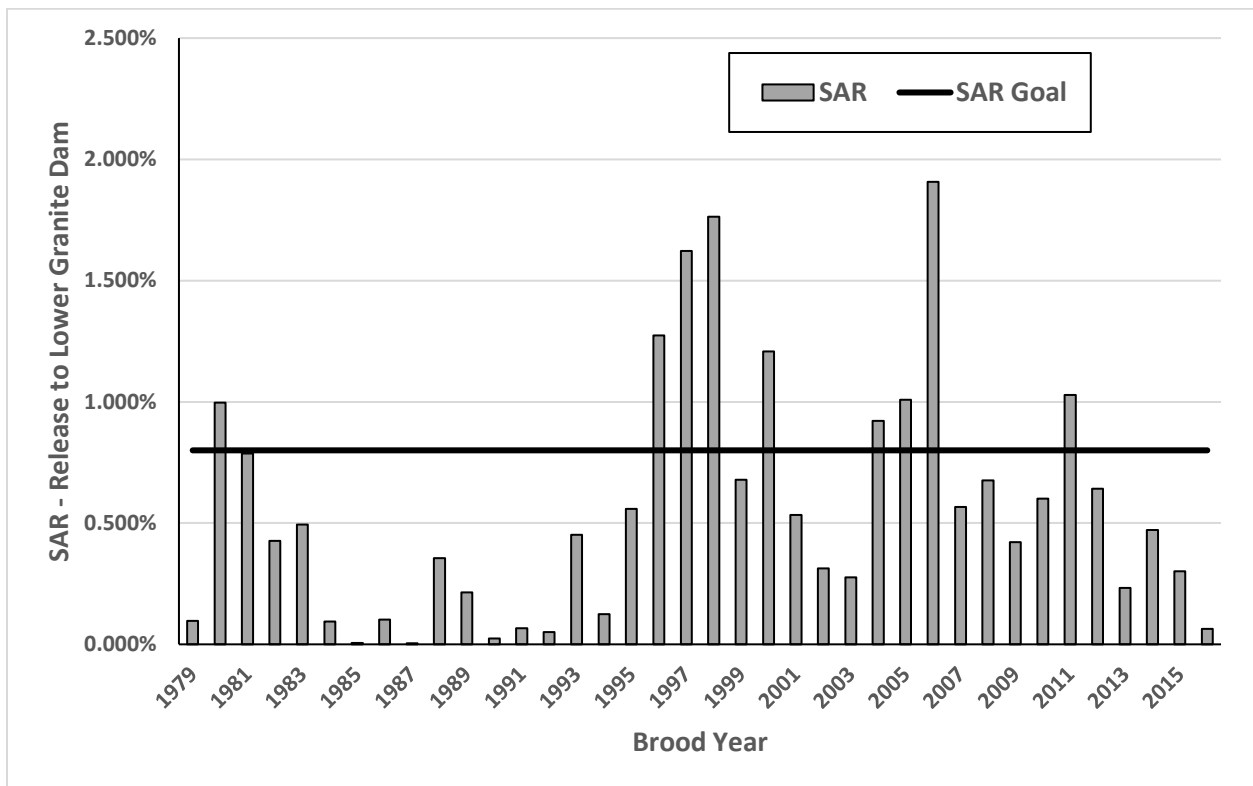


Figure 8. Smolt-to-adult return rate (SAR) of McCall Fish Hatchery summer Chinook Salmon for brood years 1979-2016.

Smolt-to-adult survival (SAS)

Smolt-to-adult survival rate (SAS) in this report is defined as the fraction of juveniles released that survive to adulthood back to the Columbia River mouth. Due to minimal harvest of spring/summer Chinook Salmon in the Pacific Ocean, returns to the Columbia River mouth represent the survival rates

prior to any human exploitation. Estimates to the Columbia River mouth are derived by backing down the Lower Granite estimates (described above) to Bonneville Dam using the stock and cohort specific PIT tag conversion rates between Bonneville and Lower Granite dams. The Bonneville estimates are then backed down to the Columbia River mouth based on coded wire tag recoveries from fisheries sampled in the Columbia River downstream of Bonneville Dam. When the LSRCP program was developed, it was assumed that the catch to escapement ratio of fish harvested downstream of the project area was 4:1. As such, based on the smolt release target of 1.0M, an SAS of 4.0% is required to meet the total adult escapement goal of 40,000 to the Columbia River mouth.

Smolt-to-adult survival rates for summer Chinook Salmon released from McCall Fish Hatchery have averaged 0.67% over the history of the program (Figure 9). The SAS goal has never been achieved.

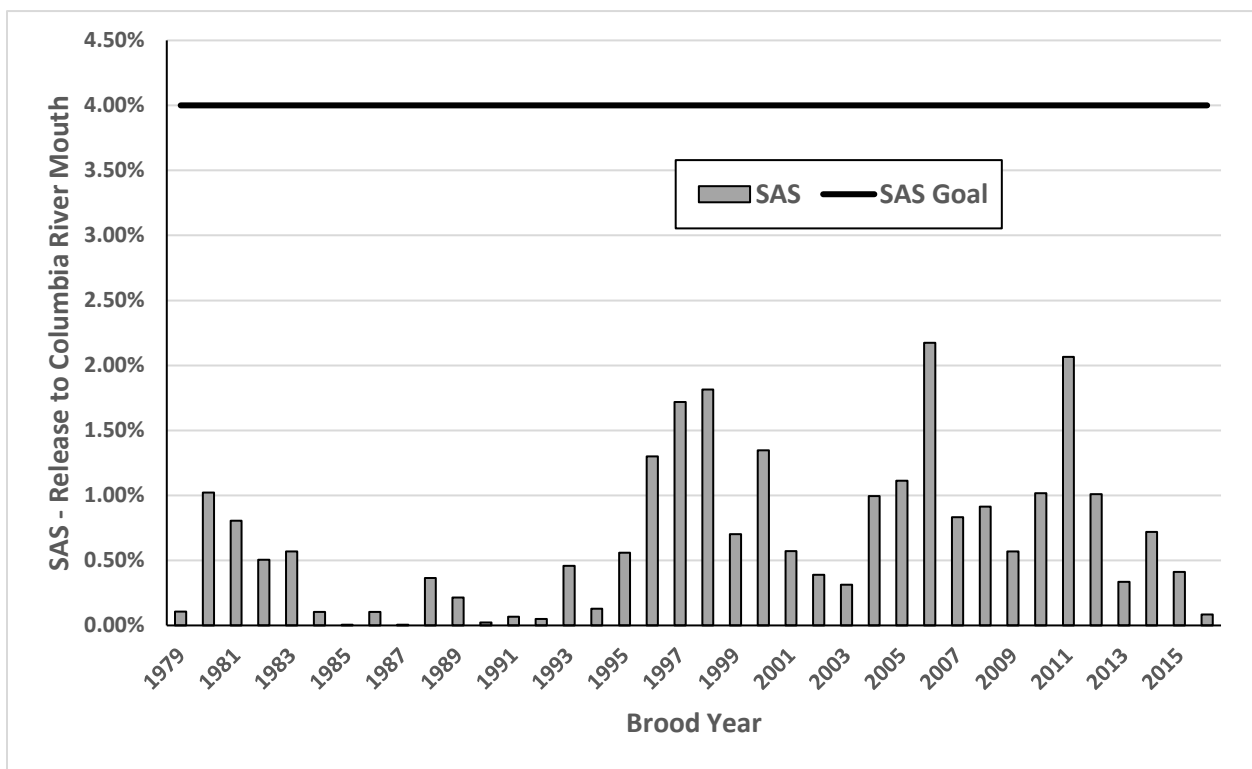


Figure 9. Smolt-to-adult survival rate (SAS) of McCall summer Chinook Salmon for brood years 1979-2016.

Recruits per spawner

The number of returning hatchery origin adults produced per adult spawned is a useful metric that captures survival over the entire lifecycle and highlights the survival advantage that occurs during the hatchery rearing phase of the lifecycle. In this report we provide the number adult recruits produced per spawner that is calculated as the number returning adults estimated at the Columbia R. mouth divided by the number of parents that were spawned for that particular cohort. The number of parents spawned

includes those spawned, the number of adults that died prior to spawning, and parents whose eggs were culled at the hatchery for disease management purposes.

The average number of recruits per spawner for the summer Chinook Salmon reared at McCall Fish Hatchery over the history of the program is 9.8 (Figure 10). The average for the most recent 10 years (BY2007-2016) is 10.3.

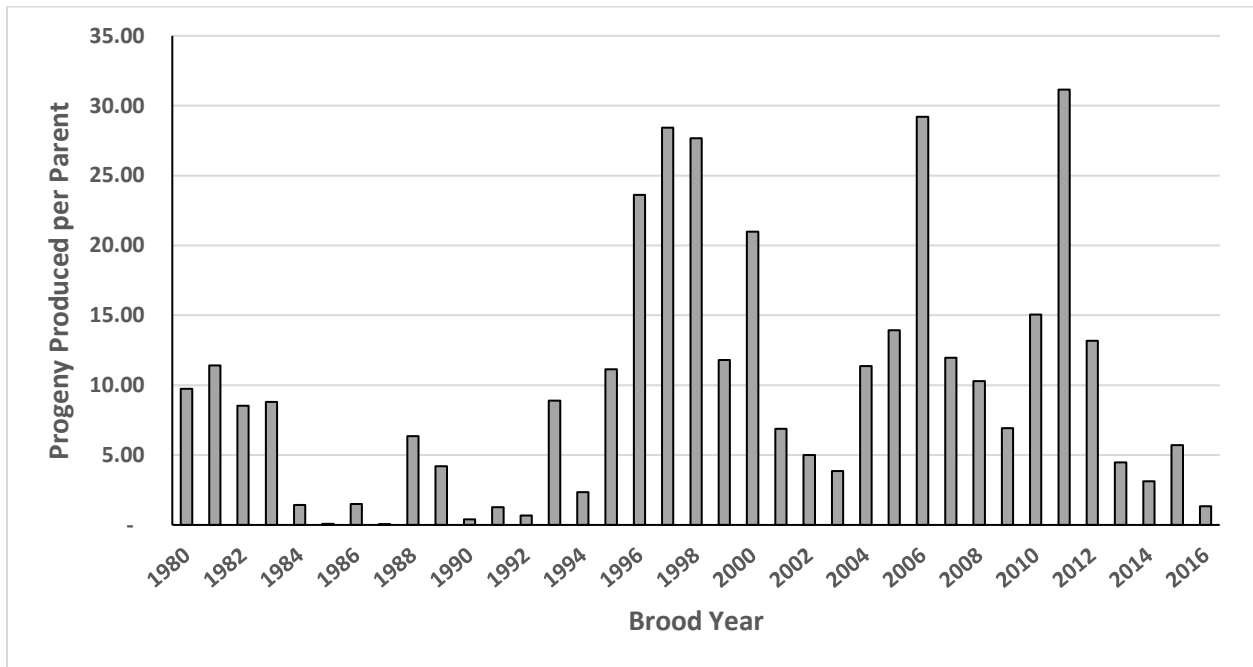


Figure 10. Adult progeny produced per parent for summer Chinook Salmon released from McCall Fish Hatchery, brood years 1980-2016.

Harvest contributions

The primary objective for the LSRCP funded fish produced at McCall Fish Hatchery is to provide for lost harvest opportunity associated with the construction and operation of the four lower Snake River hydroelectric dams.

Fisheries in Idaho

Annually, fisheries in Idaho are initially established based on pre-season forecasts of Chinook Salmon destined for return to the South Fork Salmon River. In-season, the forecasted numbers are updated based on PIT tag detections at the Columbia River and Snake River dams. Harvest shares for fisheries are based on the anticipated return to the trapping facilities and the number of broodstock needed to meet juvenile production targets. Fish returning that are in excess to brood needs are split evenly between

the tribal and non-tribal fisheries. Weekly conference calls conducted during the fisheries are used to update the projected returns and numbers of fish harvested to date.

The first non-tribal fishery in the SFSR targeting fish produced by this program occurred in 1997. There has been a non-tribal fishery in the South Fork Salmon River most years since then, apart from 1998, 1999, 2017, 2019, and 2020. Harvest during these years has averaged 2,304 (range: 364-6,843) with an average of 29,995 hours (range: 9,290-80,947) of angler effort for years that a fishery occurred (Figure 11). Harvest for the tribal fishery has occurred every year since 1997 and has averaged 443 fish annually (Figure 12).

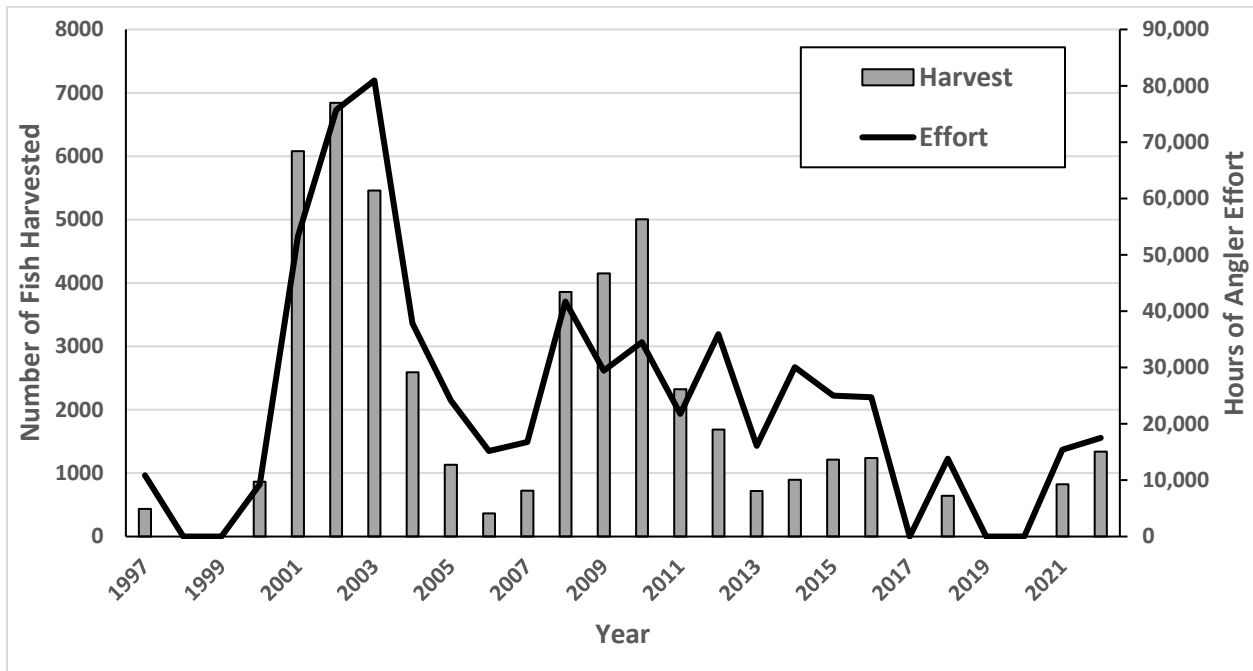


Figure 11. Annual harvest and hours of angler effort estimated from the non-tribal fishery operated within the South Fork Salmon River, 1997-2022.

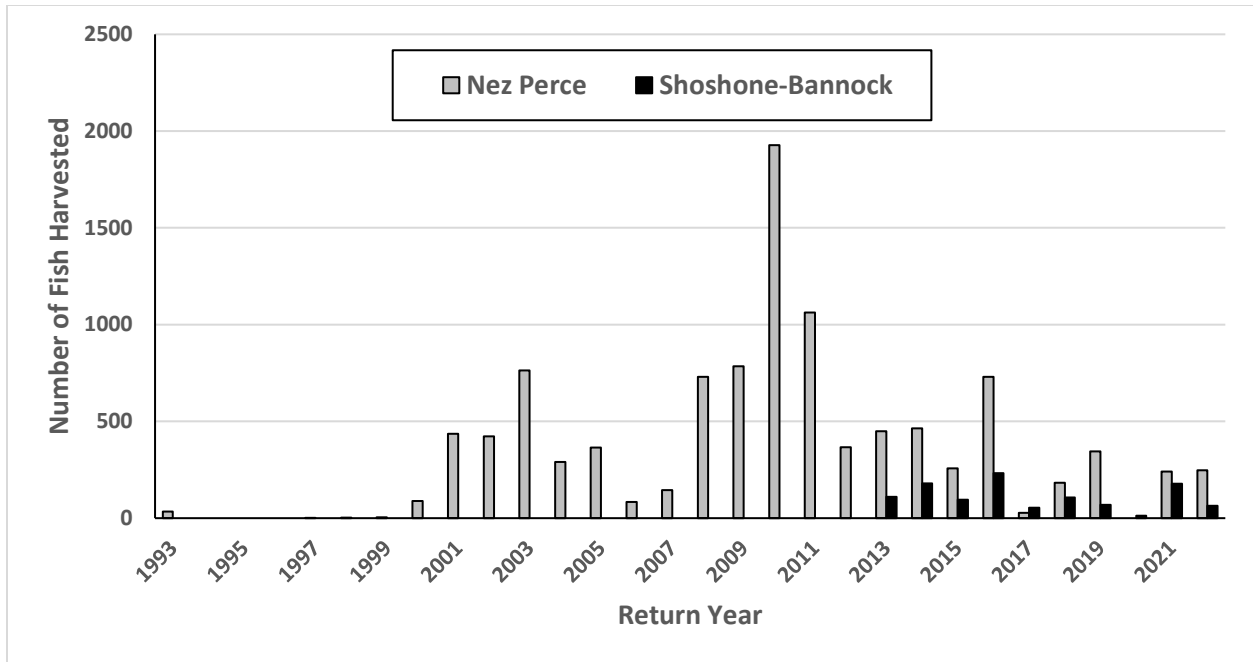


Figure 12. Annual harvest estimated from the tribal fishery in the South Fork Salmon R. for the Nez Perce Tribe (NPT) and Shoshone-Bannock Tribe (SBT) 1993-2022. Harvest estimates from the SBT prior to 2013 were not available at the time this report was completed.

Harvest downstream of Idaho

Between 1980 and 2019, summer Chinook Salmon produced by McCall Fish Hatchery have contributed to fisheries downstream of Idaho in all but four years (Figure 13). During this time an average of 820 (range: 0-6,338) fish were harvested annually.

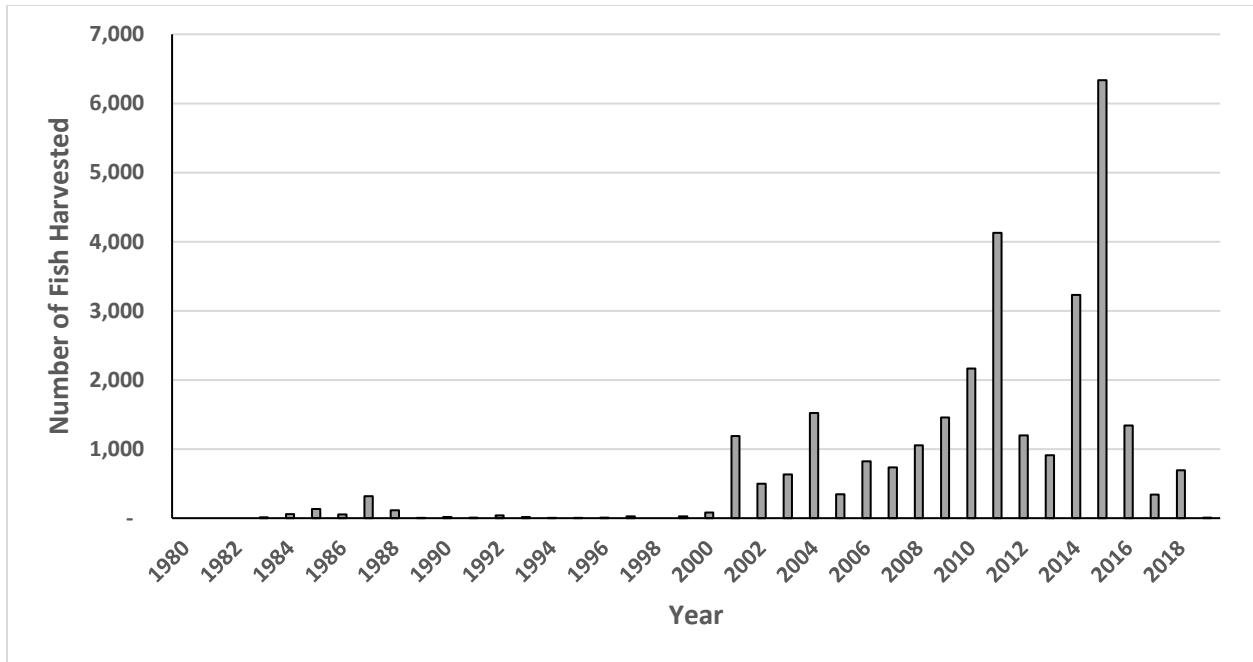


Figure 13. Number of summer Chinook Salmon produced at McCall Fish Hatchery harvested in fisheries downstream of Idaho, 1980-2019.

Results to date for the integrated broodstock and supplementation efforts

Objectives for the integrated broodstock includes targeting a Proportionate Nature Influence (PNI) of 0.50-0.67 for the population upstream of the weir on the SFSR. To achieve this high PNI, we target using 90% natural-origin fish in the broodstock (pNOB). The first integrated adults returned in 2014 and since then returns of both integrated and natural adults have been very low which is consistent with other populations in the Snake River basin. As a result, the pNOB target has not been met and the PNI target has only been met in two of eight years during the period 2014-2021 (Table 2).

Table 2. Proportion of the integrated broodstock at McCall Fish Hatchery this is composed of natural-origin adults (pNOB) and proportion of spawners upstream of the SFSR weir that are hatchery-origin (pHOS) for spawn years 2014-2021. PNI = Proportionate Natural Influence (pNOB/(pNOB+pHOS)).

Spawn Year	Observed pNOB	Observed pHOS	PNI
2014	0.86	0.54	0.61
2015	0.35	0.73	0.32
2016	0.57	0.84	0.40
2017	0.20	0.91	0.18
2018	0.38	0.82	0.32
2019	0.08	0.85	0.09
2020	0.59	0.12	0.83

2021

0.33

0.80

0.29

When comparing the mean number of recruits per female spawner from the first generation in brood years 2010-2015, females spawned in the hatchery produced on average 57 times (range: 10-133) more recruits than natural females that spawned in nature upstream of the weir (Venditti et al., 2022). This is typical of the amplification that occurs in the hatchery resulting in a much larger number of smolts produced per female compared to naturally spawning females.

Venditti et al. (2022) also evaluated the adults produced per female in nature for both integrated and natural-origin females that were passed upstream of the weir for brood years 2014 and 2015. For both years, the number of recruits per spawner for natural-origin females was similar to the integrated females but productivity for both groups was extremely low and the number of F₂ recruits was less than 10 individuals for some groups (Table 3).

Table 3. Number of F₁ females by origin passed above the SFSR weir for natural spawning in 2014 and 2015 and the total number of their F₂ progeny (includes age-3, 4, and 5 offspring) that subsequently returned to the weir. Origins include natural (NP), integrated (IB), and segregated (SS).

Spawn Year	F ₁ Female		F ₂ Recruits			Recruits per Female (F ₂ /F ₁)
	Origin	N	Male	Female	Total	
2014	NP	120	8	2	10	0.083
2014	IB	283	16	6	22	0.078
2014	SS	5	0	0	0	0.000
2015	NP	39	2	1	3	0.077
2015	IB	271	9	10	19	0.070
2015	SS	2	0	0	0	0.000

Summary and outlook for the future

Since the last ISRP review in 2010, we have continued to observe a consistent and high survival during the hatchery phase of the lifecycle and a highly variable post release survival rate. There are minimal survival gains that can be achieved in the hatchery rearing environment since the McCall program already has high in-hatchery survival and regularly meets the smolt release target, but we will seek opportunities to increase post-release performance and explore ways to increase smolt capacity at the facility. The new adult holding ponds that are being constructed should reduce prespawn mortality rates which will result in more efficient use of broodstock and therefore more fish available for harvest.

The change in broodstock management from segregated to integrated has significantly changed weir and broodstock management for this program. Monitoring and evaluation staff work closely with the

hatchery staff during the adult return to manage the broodstock composition and escapement of hatchery and natural fish upstream of the weir to meet the sliding scale targets. Due to the low abundance of natural fish, the PNI target for the population upstream of the weir has only been met in two of eight years during the period 2014-2021 but the PNI values are consistent with how the sliding scale was developed for years of low natural origin returns. We are relatively early in the evaluation phase of this supplementation effort and data from future returns will help to guide an adaptive management approach for supplementation efforts in the South Fork Salmon River.

While there are certainly bright spots during the history of this program, the total adult mitigation goal (40,000) has never been achieved. The adult mitigation goal to the Project Area (8,000) for McCall Fish Hatchery has been met or exceeded in only 11 of 42 years. However, since 2000, the average annual return to the Project Area is 8,222 adults and the McCall Fish hatchery is typically on the higher end of adult return rates for LSRCP programs operated in Idaho. This program has provided consistent tribal and non-tribal fisheries in Idaho and contributed to harvest in fisheries downstream of Idaho. The recent low returns and limited harvest opportunity are concerning, and we will look to make program modifications to generate more consistent returns to support fisheries.

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